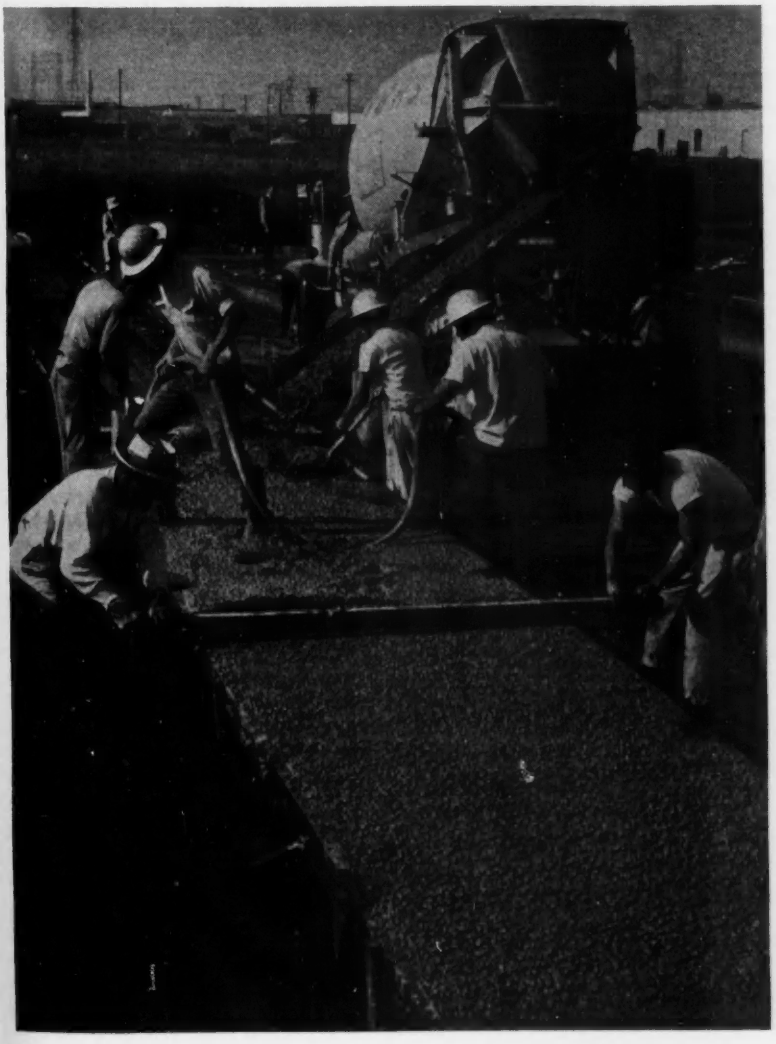
In assessing the long-range potentialities of prestressed concrete construction, don't overlook the possibilities of . . .

On-The-Job Prestressing

A ready-mix truck deposits stiff, lightweight concrete in one of the panel casting beds. The concrete is then roughly positioned by shovel, vibrated and screeded.



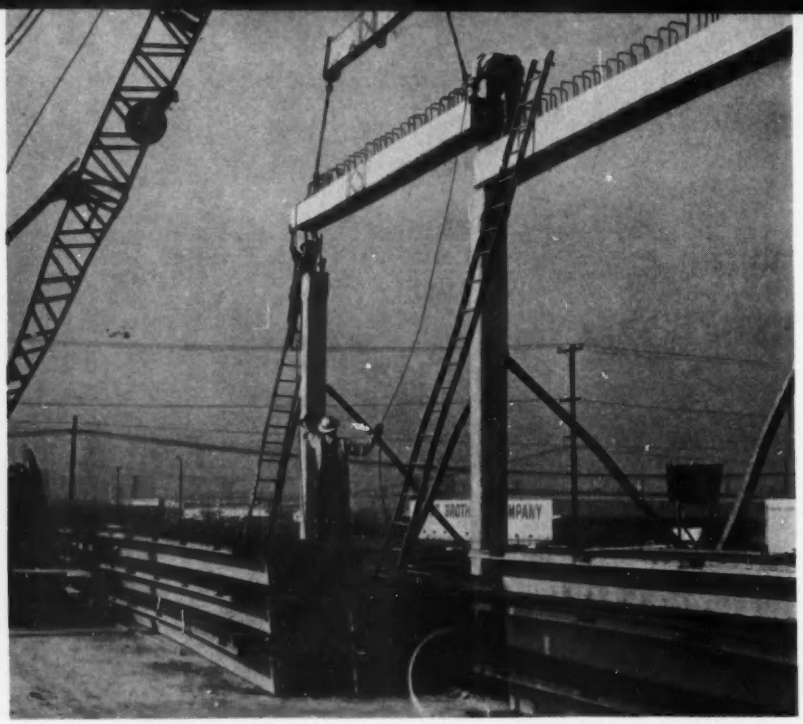
ALTHOUGH MUCH OF THE DEVELOPMENT of prestressed concrete in this country has been in connection with permanent prestressing yards, this challenging field is by no means closed to contractors who are willing to set up facilities for prestressing on their job sites. Indeed, in some cases the cost of transporting alone may tip the economic scales in favor of job-site prestressing. A case in point is a warehouse built recently in Los Angeles for the General Electric Company's Lamp Division.

As let for bids, the job called for 84 prestressed concrete girders and 496 prestressed concrete roof panels with a total area of 100,000 square feet. Only one existing prestressing yard in the Los Angeles vicinity was set up for a job of this size. A comparable San Francisco concern could not compete since shipping charges alone would have amounted to $25,000.

Among the contractors that bid on the job was a firm created by a joint venture of the Noyes Roach Company and C. L. Peck. Roach-Peck realized that competing figures on the prestressed members would necessarily be very close. They also knew that since the roof was the largest single structural element, it was the place to cut costs.

Their idea was to set up prestressing beds on the job site and thereby save transportation charges. Of course, calculations had to include the cost of designing, building and operating the beds. Nevertheless, the Roach-Peck bid proved to be the lowest.

Plans called for panels measuring



The upper photo shows the anchoring of 26-foot long girders that bear on precast columns. These girders support the 40-foot, double-tee roof panels shown stacked on the ground. The lower photo shows the first of 496 roof panels positioned in construction of the new General Electric Lamp Division warehouse.

40 by 5 feet and 18-inch by 16-inch by 26-foot girders. Beds were designed for the job at hand without particular thought given to their future use. However, some salvage was possible and, as a result, Mr. Roach believes this headstart may give him a bidding edge on the next job where an on-the-job prestressing operation is practical.

One girder and four panel beds were laid out; each rested on a 4-inch concrete slab. Beds were constructed of fabricated sheet steel forms supported by reinforced concrete beams. Sufficient anchorage was provided to handle calculated stress, but the beds were planned strictly as a temporary facility with an eye to easy dismantling and removal. The twelve cables in the girders and eight in the panels were pretensioned. Capacity of the beds was 28 roof panels and 7 girders every three days.

Combined with precast columns and tilt-up walls, this novel construction technique produced a truly permanent and fireproof building in the time and for the cost of a temporary make-shift structure. A paved parking lot covered the remaining traces of the beds after completion of the building.

On-the-site prestressing seems a likely approach to other jobs where extensive use is made of prestressed members and no casting yard is nearby. Perhaps prestressed concrete sub-contractors will develop portable casting beds that may be economically moved from site to site. In any case, on-the-site casting is well worth consideration on jobs of this scope. END

Here's a technique for safely picking up concrete slabs and other elements cast at ground level without the necessity of providing handling equipment.

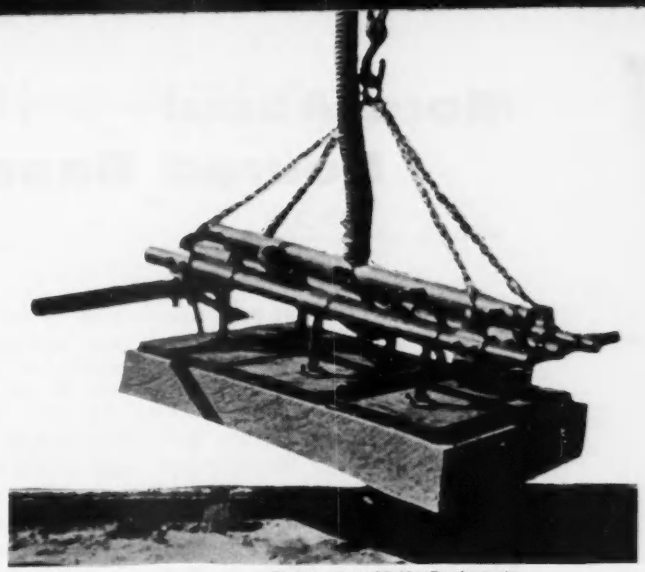


Photo courtesy of Rubber Developments

Closeup of a vacuum mat holding a small concrete slab in suspension.

Vacuum Mats for Lifting Concrete

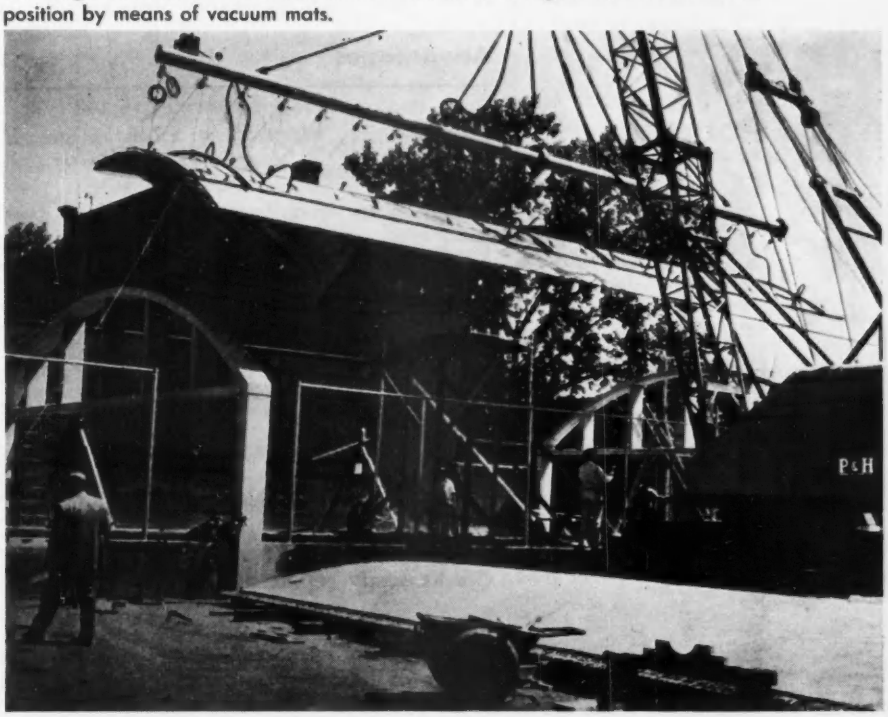
ONE OF THE DIFFICULTIES that arises in connection with casting concrete slabs and thin-shell structural elements on the ground, and later lifting or tilting them into position, is that of providing the special reinforcing steel to withstand stresses that will be present only during the handling operation. Some designers and builders are now doing away with handling reinforcement altogether by performing the lifting operation with rubber vacuum mats.

The method has the important advantage of widely distributing the stresses which develop during handling, rather than concentrating them in relatively small areas, as is the case when hooks or lifting lugs are cast into the concrete. Reports also indicate that slabs lifted in this manner are much less likely to sustain damage due to whipping.

The use of vacuum mats for this purpose is an outgrowth of the vacuum curing process in which mats are employed to extract mixing water from concrete after it has been placed. In the latter process water is withdrawn from the concrete by creating a vacuum between the mat and the surface of the unit; in the lifting operation the vacuum is used to develop friction between the surface of the concrete and rubber strips attached to the mat. Maximum lifting capacities produced in this manner are said to run 600 pounds per square foot of mat in the horizontal plane and 400 pounds per square foot in the vertical plane. The method appears to work equally well on both flat surfaces and curved surfaces, and even cylindrical units, such as large-diameter concrete pipe, seem to present no serious difficulty.

Vacuum lifting has some interesting possibilities in connection with post-tensioning work, where prestressing steel is to be inserted in preformed ducts after the members have been lifted into position. By eliminating the problem of handling stresses, the lifting mats make it possible in some cases to cast beams and slabs without reinforcing steel. After the members are swung into position in the structure, the steel is inserted and tensioned to obtain the desired structural characteristics. END

This large thin-shell roof unit was cast and cured on the ground, then lifted into position by means of vacuum mats.



More About Poured Basements versus Block

AMONG THE INTERESTING RESPONSES which this publication received concerning its article "Poured Basements versus Block" (December 1956 issue, page 9) was one from Lester Rowlson, treasurer of the Poured Concrete Wall Association of Detroit, Michigan. Mr. Rowlson, who is also an executive with the Concrete Wall Company of Detroit, is currently serving on a five-man committee which is seeking to draw up recommendations for improved, economical residential basements. In addition to the Poured Concrete Wall Association, the committee has representation from the City of Detroit Department of Building and Safety, the FHA, and the concrete block and ready-mixed concrete industries.

Mr. Rowlson is well qualified to comment on the comparison drawn between poured and block basements in our December issue, for over the last eleven years he has contracted thousands of formed concrete structures of many types in the Detroit area, and his has been one of the leading voices urging higher standards of workmanship. Admitting that there is a lack of effective rules and standards for insuring the better product we are all seeking, Mr. Rowlson takes mild issue with the comparison chart prepared by the Milwaukee Home Builders Association.

Since Concrete Construction's total reading audience has grown by almost six thousand since last December, we are reproducing on this page the original comparison between poured and concrete block basements so that our present audience will have a better opportunity to understand Mr. Rowlson's comparison on the facing page. He has used some of the bases for comparison incorporated in the original discussion, and added other factors which we believe have resulted in a far more meaningful chart.

As Mr. Rowlson points out in his letter, the subject is a highly controversial one, and too many expressions of opinion regarding it reflect far more prejudice than actual knowledge. We published the Milwaukee Home Builders' study because we thought it represented a serious effort to approach the subject objectively, and not because it made a case either for or against any particular type of construction.

The day somebody succeeds in developing an all-purpose, economical construction material that has no serious shortcomings, and that is in no way dependent for adequate performance upon the quality of craftsmanship on the job—that day we will all go out of business. Until that happens, we are glad that there are people like Mr. Rowlson and his committee around who are interested in developing standards which will insure the better product all serious builders are seeking. END

Evaluation of Basement Types—MILWAUKEE

Courtesy of Milwaukee Builders Association

	Advantages	Disadvantages
Poured	Stronger. More waterproof. Finish more versatile. Potentially lower cost. Fewer call backs.	Curing time longer (4 days). Few contractors. Cracks almost impossible to repair. Winter work at present time. more difficult.
Block	Public acceptance. Cost advantage. Quicker. Block always available. Mason's familiarity. Cracks easily repaired. Partition walls easier to build. Acoustical absorption-plants will take back surplus.	Call backs. Structural failures. Leakage. Fresh block shrinkage. Chipped block—poor appearance.

Evaluation of Basement Types—DETROIT

Courtesy of Poured Concrete Wall Association, Detroit

SUBJECT	POURED	BLOCK
Allowable working compressive stresses	500 lbs. per square inch.	Hollow—70 lbs. per square inch. Solid—125 lbs. per square inch.
Strength ratio	Seven to Four to	One—(hollow) One—(solid)
Cracks, horizontal	Very rare. Good strength of poured concrete resists lateral earth pressure, etc.	Quite common. Lateral earth and frost pressures are frequent causes.
Cracks, vertical	If shrinkage, wet mix may be cause. Other cracks may develop due to temperature change, soil movement, lateral earth pressure, etc.	If shrinkage, green and/or wet block may be cause. The same other causes exist but since block is weaker, cracks are more frequent and severe.
Leakage	Source of incoming water always apparent. Water must go through or over walls and so the source can easily be stopped.	Source of water may be far from inside dampness. The water often travels through voids; source hard to locate.
Crack repair	Easy to fix—hard to camouflage.	Hard to fix—easy to camouflage.
Costs	Initial costs similar. Labor and material both lower.	Structural failures may cause overall average costs to soar.
Speed	5 men complete full job daily. May be inspected on third day. Backfill safely after 3 more.	Several more man days required for erection. Walls seldom strong enough to withstand backfill without shoring.
Contractors numbers	A lot of knowledge and a large equipment investment needed to undertake competitive basement contracting.	Short training and only a few tools—pickup, trowel, mortar box and two wheelbarrows puts the mason in business.
Workmen's familiarity	Carpenters erect forms. Mistakes and shortcuts most apparent on surface.	Masons lay block. Mistakes and shortcuts easily hidden or camouflaged.
Winter work	Quite safe with wood forms, heated materials, and Calcium Chloride. Concrete is not appreciably harmed by freezing if the heat is retained for the first 16 hrs. In Detroit we pour when temperature is as low as 15 degrees.	Masonry work becomes impractical when the same necessary protection is specified. Mortar is as severely damaged by early freezing as concrete and the thin layer of mortar generates very little heat. Heat necessary below 30 degrees.
Insulation	Poor heat factor. Effective against wind penetration.	Better heat factor. Poor against wind penetration unless sealed on surface.
Acoustics	Poor—like plastered walls. Surface can be textured for improved acoustics.	Better—especially with rough textured units.

This photo, which also appears on the front cover, shows a workman placing tin cans over halved rubber balls which were previously nailed through their tops to the forms. The upright position of the cans is securely maintained by the 2x4 boards placed over them.

Some real ingenuity went into the development of a simple method for perforating this ball-room thin-shell ceiling with 30,000 2-inch diameter holes.

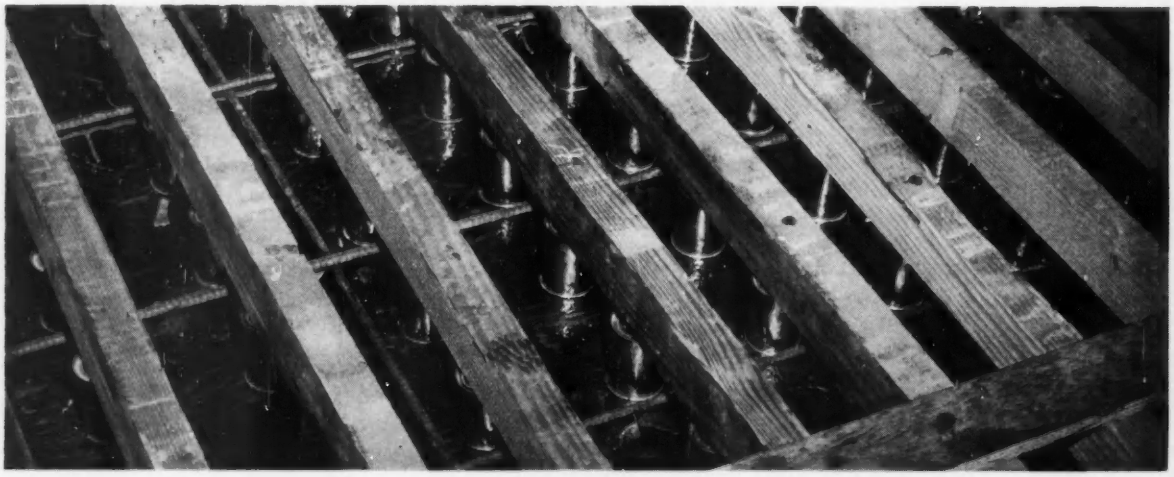
First Acoustical Thin-Shell Ceiling

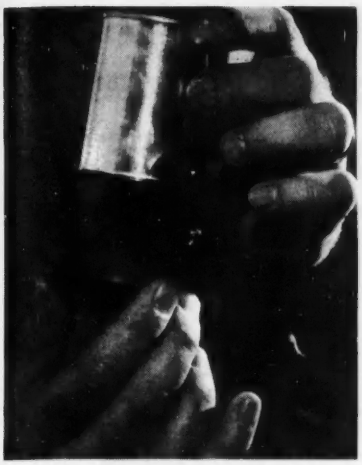
SUCH UNLIKELY ELEMENTS as 5,000 rubber balls and 30,000 ordinary tin cans have played a leading role in what is believed to be the first acoustical treatment of a thin-shell concrete ceiling in this country. The work involved an entirely new acoustical engineering technique developed just for a new $2 million ballroom and exposition hall for the Chase Hotel in St. Louis.

Developed by Harold Koplar, president of the hotel (and also a graduate architect), the method provides a needed means of casting acoustical properties right into thin-shell ceilings, thus doing away with the necessity of relying entirely upon fixing tile, plaster or other acoustical materials to the underside.

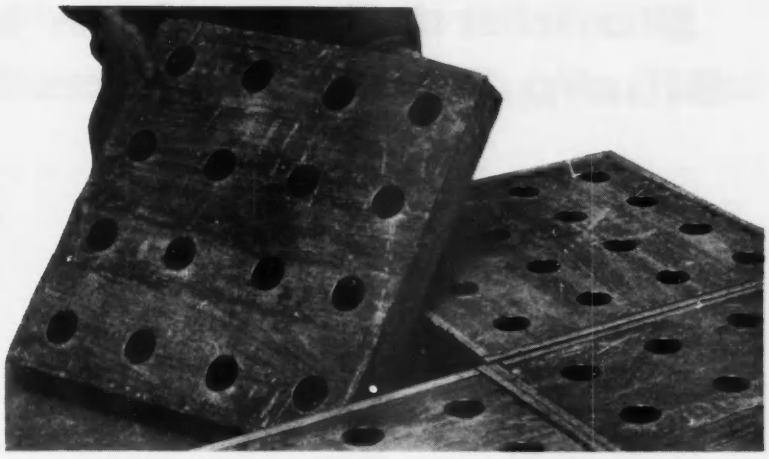
The tin cans and the rubber balls were used as the most practical and economical means of casting 30,000 2-inch diameter holes clear through

Closeup of forms shows 2 x 4's nailed to the tops of the cans to insure they would remain upright when concrete was placed and vibrated around them.





The theory of the first acoustical ceiling is clearly illustrated above.



Sections of concrete with 2-inch diameter holes made in three inches of concrete, by the open end of the cans, were used for testing strength of ceiling.

the 3-inch thick reinforced concrete ceiling. Here is how it was done:

The 112- by 156-foot ceiling was poured in three sections, and onto the top of the wooden forms built to support each section were nailed 10,000 halves of 2-inch diameter rubber balls. Then the open ends of 10,000 2-inch diameter by 3-inch deep tin cans were pressed down over the rubber hemispheres, the latter serving to position the cans accurately and to hold them in an upright position. The balls were located in parallel rolls and spaced about 6-inches center-to-center in each direction to allow about 4-inches of solid concrete between perforations to carry reinforcing rods.

As additional protection against the possibility of the tin cans being tilted during pouring operations, 2 by 4's were placed on them and nailed through their tops. Concrete was then placed and thoroughly vibrated around the cans. After it had set the 2 by 4's were removed and the tops were cut out of the cans. Our information doesn't include any revelation of how this last operation was performed, but it is fair to presume that the technique used must have been something very like conventional can opening.

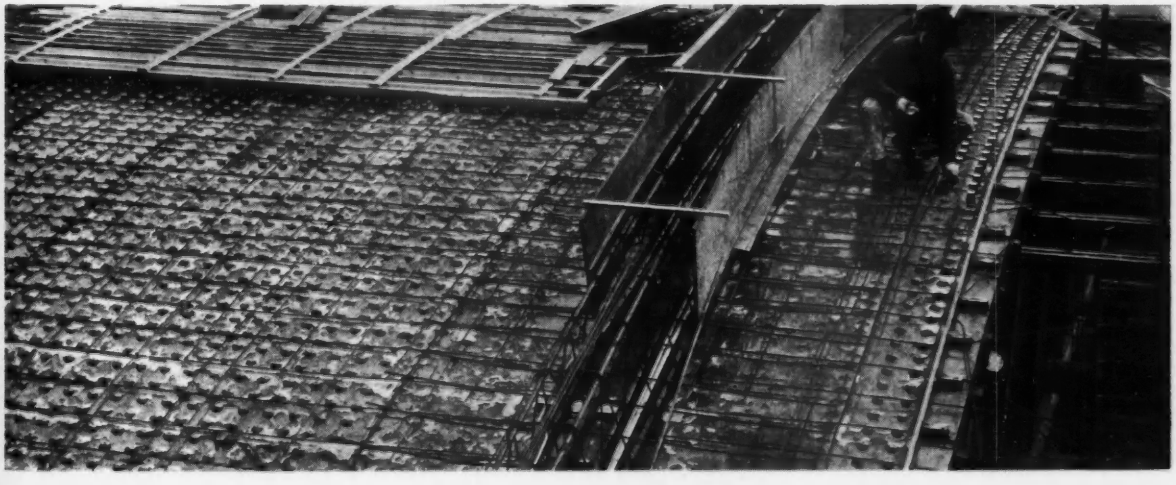
After an adequate curing period, the forms were stripped, removing 10,000 rubber ball halves from as many tin cans and leaving 10,000 tin-lined 2-inch diameter perforations through the concrete. The same forms were of course reused for each of the two remaining thirds of the ceiling.

One of the striking features of the perforated treatment is that it accomplishes the integration of acoustical treatment with thermal insulation. In this case fibre-glass insulation placed between the ceiling and the protective roof covering also serves to absorb low-frequency sounds passing through the 30,000 holes in the concrete. The perforated ceiling is also reported to be strikingly attractive. In the ceiling areas where there are no tin cans, a ⅞-inch thick coating of acoustical plaster has been applied to absorb high-frequency sounds.

The Chase Hotel ballroom provides seating for 2,500 persons in auditorium setting and 1,800 in banquet arrangement. The exposition hall below the ballroom has 18,000 square feet of floor space for 150 exhibit booths.

The thin-shell ceiling is stiffened at 30-foot intervals by post-tensioned ribs located above the shell. The cost of the ceiling has been estimated at about $2.90 per square foot. The work was done by the Fruir-Colnon Contracting Company, and the architect for the project was Hugues Brussel. END

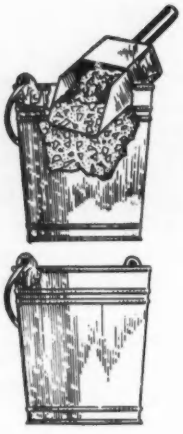
View of the ceiling in preparation for concrete placement, which was handled in three sections using total of 30,000 cans and 10,000 rubber ball halves.



Standard Procedure for Making Slump Test from Plastic Concrete

Drawings courtesy of Ohio Ready Mixed Concrete Association

1 Obtain a *representative* sample of freshly mixed concrete. Two bucketsfull, with about 40 pounds of concrete in each bucket, is about the right amount.

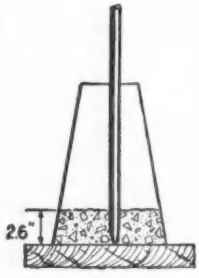


To obtain representative sample, take 3 batches from mixer while discharging.
Approximately ⅓ from 1st part of load
⅓ from 2nd part of load
⅓ from 3rd part of load
Then REMIX concrete.

2 Next, moisten inside of cone, and place it on a short plank at least 10 inches x 24 inches. Be sure that plank rests firmly on the ground, in a level position. Hold slump cone firmly in place by standing on the foot pieces.

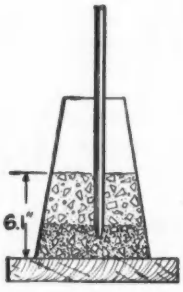
CAUTION: Do not use anything except the standard size rod (⅝ inch diameter x 24 inches long) for rodding concrete.

3



Fill cone ⅓ full and rod this layer exactly 25 times with bullet pointed iron or steel rod. Distribute rodding evenly over the area.

4

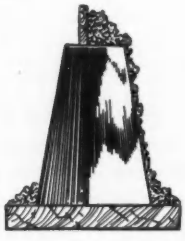


Fill cone with second layer until ⅔ full and rod this layer 25 times with rod penetrating into but not through the first layer. Rod evenly over entire area.

5

Overfill cone slightly and rod top layer exactly 25 times, with rod penetrating into but not through the second layer. Rod evenly over entire area.

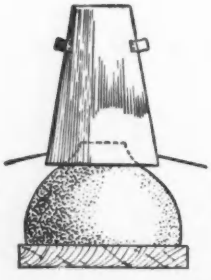
6



Use short board to scrape off excess concrete from top of cone and clean around bottom of plank.

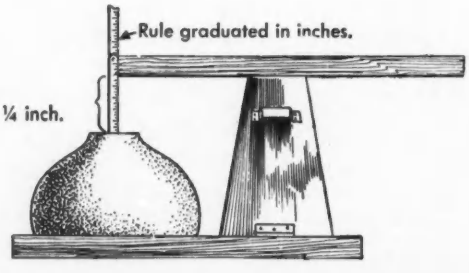
Note: ⅓ or ⅔ full means ⅓ or ⅔ of the volume, not the depth of the cone. See dimensions shown above. In practice, estimate but do not measure these heights.

7



Slowly lift cone vertically. Avoid jarring concrete as it slumps. Plank must be wide enough to permit concrete to spread as it slumps.

8



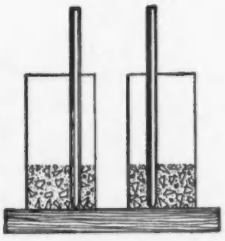
Set slump cone on plank, and lay a short straightedge across top. Measure amount of slump as shown (from bottom of straightedge). After slump has been measured, waste concrete. DO NOT use for cylinder strength tests.

Standard Procedure for Making Concrete Cylinders for Strength Test

Steps 1 through 8 outline procedure for making Slump Test.

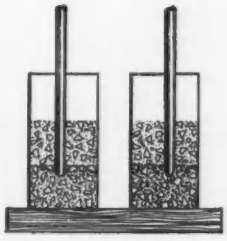
Drawings courtesy of Ohio Ready Mixed Concrete Association

9



Place a pair of cylinder molds on a short board. Fill each ⅓ full of a representative sample of freshly mixed concrete. Rod each layer exactly 25 times, evenly over the entire area.

10

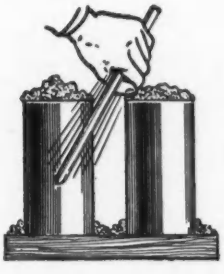


Fill pair of molds with second layer until ⅔ full. Rod this layer 25 times, with rod penetrating into but not through the first layer. Distribute rodding evenly over the entire area.

11

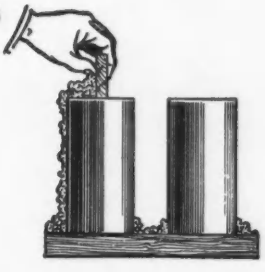
Overfill cylinders slightly and rod top layer 25 times. Rod should penetrate into but not through the second layer. Continue to distribute rodding evenly over the entire area.

12



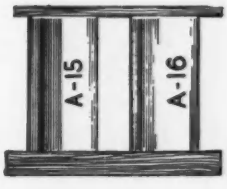
Tap cylinders lightly all around to remove entrapped air, and to close voids left by rodding.

13



Screed off and finish top with straightedge and trowel smooth.

14



Mark with identification number and place in curing box.

DO NOT PLACE CYLINDERS WHERE THEY WILL BE SUBJECT TO MOVEMENT OR VIBRATION

15

Identification numbers of cylinders_____

Date made_____ **Made by**_____

Slump of concrete_____ **Class of concrete**_____

Structure or member represented_____

Record the data indicated above.

GENERAL NOTE: After cylinders have hardened (24 hours or more after making) they shall be transferred to storage under the curing conditions desired.

For further details on the making and curing of cylinders, see ASTM Specifications: C 143-52; C 172-52T; C 31-49.